Testing Oxalic Acid (OA) for Varroa Mite Control

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Objective

1. To determine if Oxalic Acid (OA) is an effective and safe control of resistant Varroa mites in three climates: Mediterranean, Arid desert and humid SE U.S.

Problem and its Significance:

Honey bees are the main pollinators of Almonds in California. Honey bees are being parasitized by *Varroa destructor* worldwide, and the acaricides used for Varroa control (fluvalinate and coumaphos) have become ineffective. The mites' resistance to these chemicals is becoming widespread and beekeepers need another control alternative until the mite-resistant bee stock becomes more reliable.

Oxalic acid (OA) has been used successfully in Europe to control Varroa. One method is to spray OA on the bees that are on broodless combs; mite mortality of 82-99% has been reported with this method. In another method, OA in sugar syrup is trickled between combs; the mortality rates of 89-97% were reported. There have been no reports of Varroa developing resistance to oxalic acid. It is suggested that Varroa will not develop resistance to organic acids since they are natural parts of the metabolism of all organisms and cannot be rendered harmless through enzymatic effects.

Because OA works through contact, rather than evaporation, ambient temperature is not a critical consideration for efficacy (Review, 2001). While the mode of action is not clearly understood, it appears that the low pH of the OA is a factor. The effect of humidity on mite mortality, however, may be different. This has been tested in the laboratory and humidity may affect mortality rates of Varroa. OA needs a minimum level of relative humidity to keep its efficacy high (Nanetti, pers. comm.). Since other studies were conducted in northern climates or Mid-Atlantic States, we wish to investigate if different climatic conditions affect OA efficacy so that beekeepers from all areas of the U.S. can use it effectively. We will compare treatment results in Arizona, Tennessee and Italy.

Experimental Design

A minimum of twenty four 10-frame deep Langstroth hive bodies of bees were used, per experimental location. For the preliminary tests, colonies located in Tucson Bee Lab and in TN and Italy were used. For each test apiary there were a) at least 8 treated with OA; b) 8 treated with Sucrocide™ and c) 8 control (no treatment). We chose Sucrocide as the second treatment, because it has not been tested in dry climates, its application is similar to the application of OA (Stanghellini and Raybold 2004), its efficacy is similar to OA and it is commercially available.

For the first treatments, colonies received one application, in mid summer 2005 when mite populations were high enough to give good results. Normally, OA solution is applied once in the late autumn/early winter when little or no brood is present.

However, bees in moderate climates have brood almost year-round and we wanted to test the effect of were be monitored between treatments. Each colony was assessed for brood and bee populations pre- and post-treatment. We current have expanded the experiment with field cooperators in CA (G. Brandi) MN, (Bergling), CO (L. Johnson) and others.

Materials and Methods

Mite Population: To monitor mite populations a sticky board is used that needs only one-third of the board counted (see Fig. 1). The boards (Great Lakes IPM, MI) are coated with a sticky substance to catch mites. To keep bees from getting caught, an 8-mesh wire sheet of hardware cloth (cut to fit the board) with its edges folded under, is stapled on each board. Sticky boards are installed for three days prior to treatment to determine initial mite levels in the equalized colonies and during, and after, treatments to monitor mite mortality.

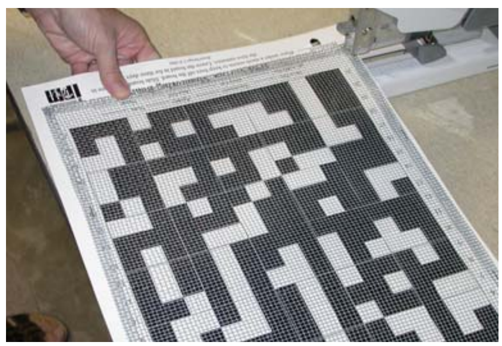

Figure 1. A sticky board to monitor mite levels.

Humidity: Dataloggers or iButtons were used to record temperature and humidity levels continuously. They were set at 1 hour intervals at the top of the hour to coincide with weather data. iButtons were placed in 3 colonies per treatment and one in an empty box for ambient temps.

Oxalic Acid

A 3.2% OA solution is used. One litre (L) of water is mixed with 1 kg sucrose white sugar) for the sugar syrup. Under a hood, 75 g oxalic acid dihydrate (which contains 53.6%) oxalic acid is added and mixed together with the syrup thoroughly. The resulting solution (3.2% OA w/v) treats about 25 hives (10 frames). A large-volume syringe (150 mL) is used to apply measured doses (see Fig. 2) of the sugar syrup/OA mixture. The dose is 5 mL per deep comb. If the frame size differs from a deep, the dose is adjusted proportionally.

Fig. 2. Applying OA solution with a syringe.

Doses were applied on bees that fill the inter-space between two frames, end to end, and on the frame top bars (if the weather is too cold). A single doese5mL was used for each frame per hive body containing bees. All honey supers were removed prior to all treatments.

Sucrocide

The other test colonies were treated with Sucrocide™. Label directions require making three treatments at 10-14 day intervals when brood is present. We have been applying 2 oz (59 ml or 12 tspn.) to each inter-space between frames using a compressed air Chapin® sprayer at 20 psi (pounds per square inch) through a Chapin® 0.2 GPM (gallons per minute) flat fan nozzle (8 seconds gives dose). The nozzle design allows the tip to be guided between the frame spaces during application (see Fig. 3).

Control colonies received no treatment. Miticide strips (Apistan or MiteCheck) were used for post treatment clean up. If mites are resistant to the acaricides, post treatment mite populations were estimated using sticky boards or using another material (Api-life Var, Italy). As some test colonies may have Small Hive Beetles, the efficacy of OA on this new pest will also be assessed.

Fig. 3. Applying Sucrocide with a sprayer fitted with a fan nozzle.

Results to Date

We are still accumulating data at this time. Some beekeeping collaborators are waiting for mite levels to reach approach populations so treatment differences can be documented.

Italy: Preliminary raw data from Italy are shown in Fig 4 -6. First, the humidity data are shown in Fig. 3. This gives us an overall idea of the humidity levels in Italy at the time of treatment. Next, the overall efficacy of treatments is reported, showing that Sucrocide gave 23.3% control, while OA and Api-life Var gave 72.3% and 76.3% respectively. As illustrated in Fig. 4 the efficacy of treatments suggest that Sucrocide is not as effective as Oxalic or Api-life Var (a product with essential oils). Api-Life Var is used because in Italy, the Varroa mites are resistant to all other known chemical treatments. Italy has had mites since the mid 1970s, so resistance to miticides is a real and widespread problem.

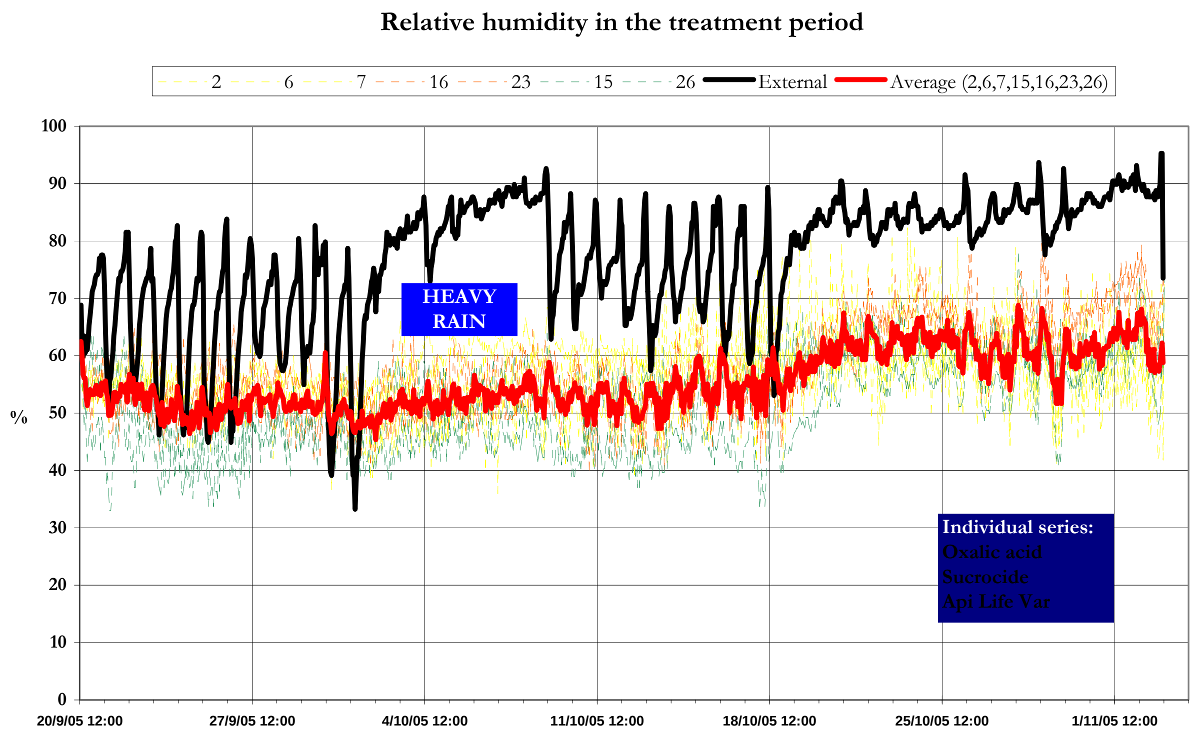

Fig. 4. Datalogger information on humidity and temperature variations during the trial.

The number of varroa still alive at the end of the treatment is represented in Fig. 5 with Sucrocide showing over 2300 mites alive after the treatment, higher levels than Oxalic or Api-Life Var colonies.

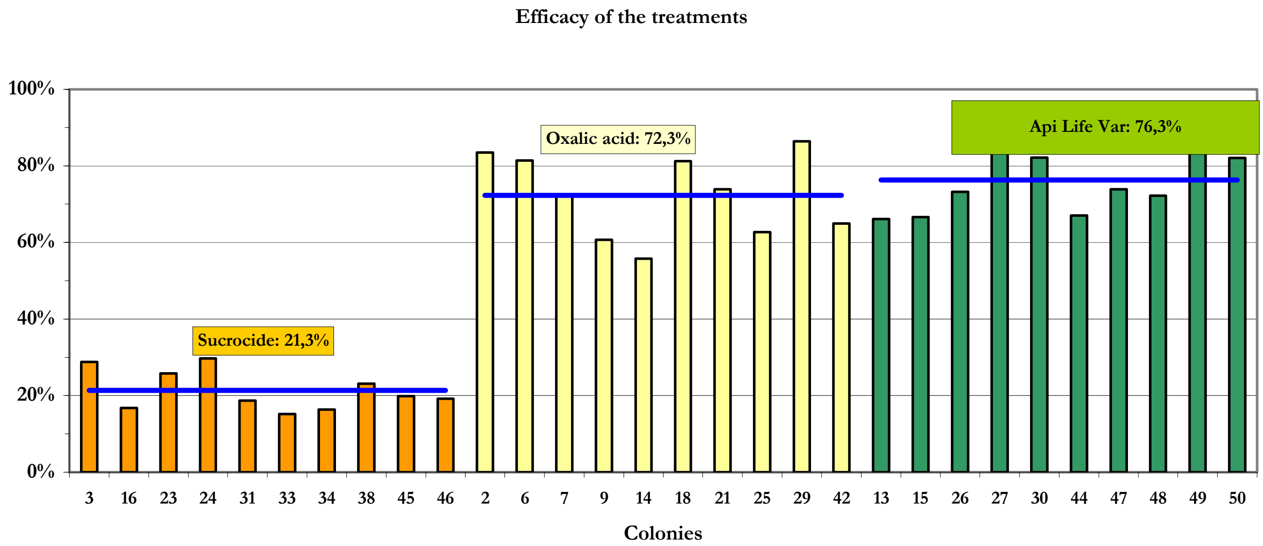

Fig. 5. Efficacy of treatments in Italy.

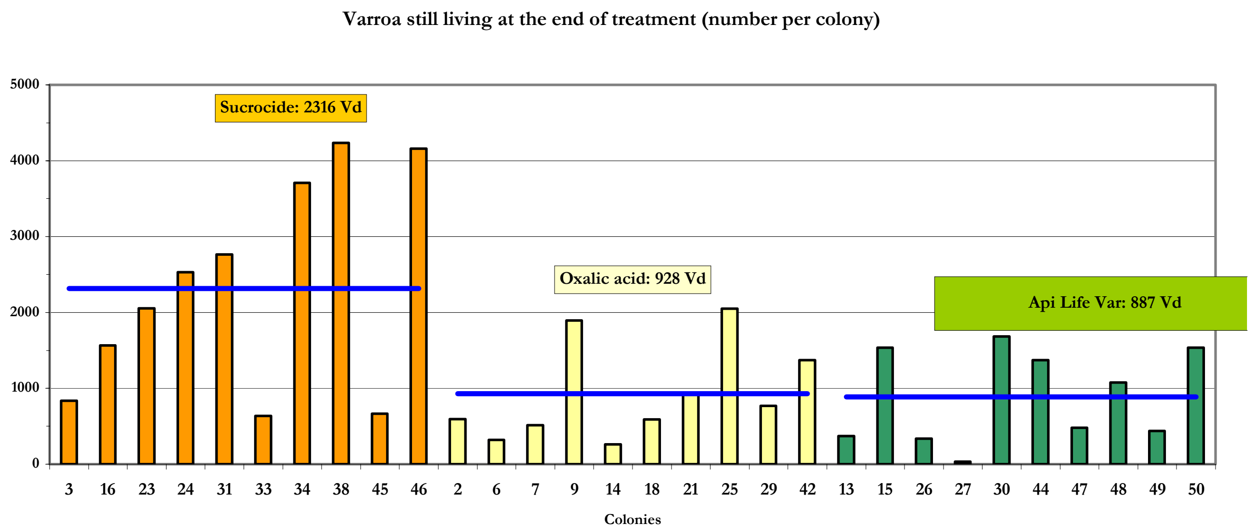

Fig 6.Number of varroa still alive after treatments, Italy.

Arizona: We were using colonies that had some Africanized bee traits and the equipment was in some cases old and needing repair. We replaced the narrow entrance bottom boards on all colonies for the duration of the trial, to accommodate the sticky boards. Despite these setbacks we were able to treat the colonies. Datalogger data are still being analyzed.

The data collected for the Arizona trials show a similar pattern as with Italy-Sucrocide giving 37% control which is similar to the no-treatment controls (34%). OA gave the highest mite control at 69% (see Fig. 6).

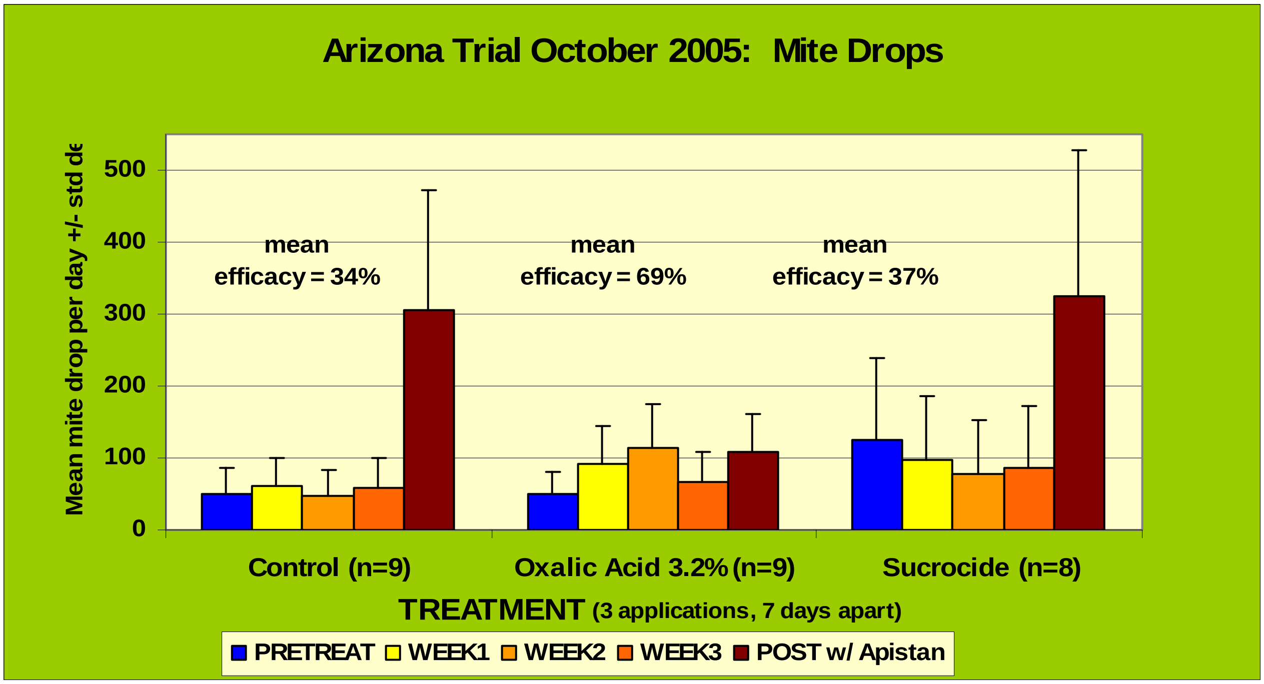

Fig. 6. Arizona Treatments showing mean efficacy.

Other cooperators, in Tennessee, Arkansas, North Carolina and Oregon are still being assessed. Some of the preliminary data are shown in Figs. 7 and 8. These data point up a similar trend in the treatment efficacy, with OA giving the best overall control.

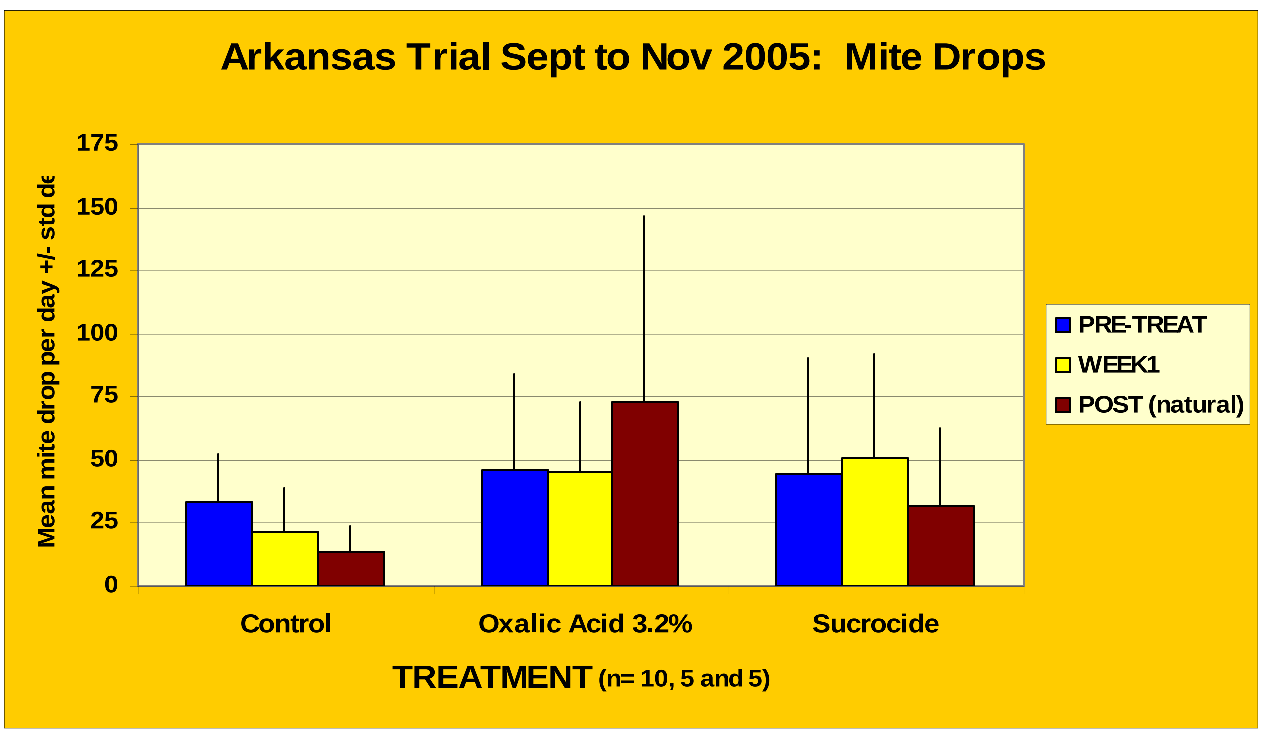

Fig. 7. Arkansas preliminary data.

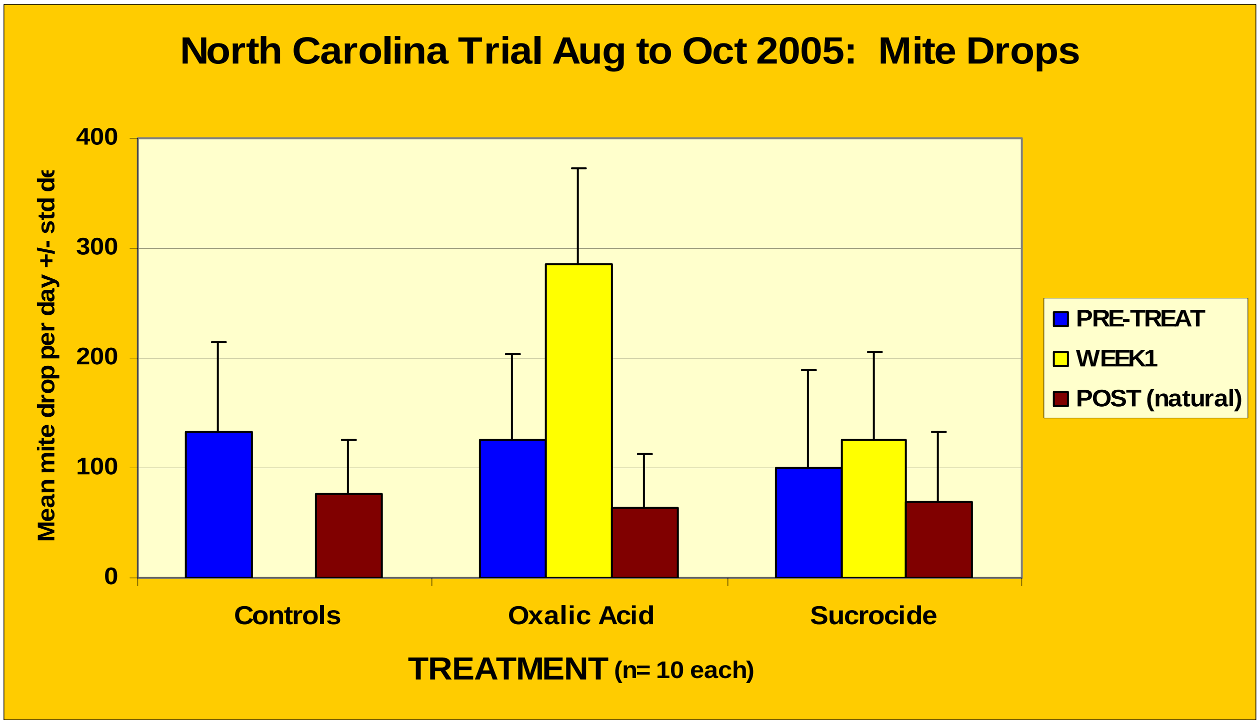

Fig. 8. Preliminary data from North Carolina.

We are still tabulating data, as mite boards are still being returned and counted. However, the results to date, as shown in the graphs given, illustrate a similar trend—Sucrocide appears to have a lower mite control impact than either OA or in the case of Italy, Api-life Var.

Future Research

In another month we will have processed all the data to write our summary article for the bee journals. The second phase of this experiment will begin as the mite levels climb in late summer. We will be testing different preparations for OA and Sucrocide to improve efficacy of both products, and lower the hazards in applying OA.

Literature Cited

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